

## 4-2 Operations with Matrices

## 4-3 Multiplying Matrices



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Norcom is a company that runs 3 factories to produce their 4 most popular products.

During the first week of the month, their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	6	3	2	0
Factory 2	0	4	8	5
Factory 3	4	2	1	0

Put the following data into a matrix.

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix}$$

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During the second week of the month, their production schedule changes and their output, measured in units, is as follows:

	Product 1	Product 2	Product 3	Product 4
Factory 1	3	3	0	1
Factory 2	0	6	5	2
Factory 3	10	2	0	1

Put the following data into a matrix.

$$B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

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$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

What is the total production for each product at each factory after 2 weeks? (express in a matrix)

$$A + B = \begin{bmatrix} 9 & 6 & 2 & 1 \\ 0 & 10 & 13 & 7 \\ 14 & 4 & 1 & 1 \end{bmatrix}$$

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Matrix addition and subtraction

- matrices must have the same dimensions
- each element is added/subtracted to the element in its corresponding location

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$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

Suppose Norcom needs to meet a large order,  
how much production would they have if,  
during the second week, they are open twice  
as long? (express in a matrix)

scalar mult.

$$2B = 2 \begin{bmatrix} 3 & 3 & 0 & 1 \\ 0 & 6 & 5 & 2 \\ 10 & 2 & 0 & 1 \end{bmatrix}$$

$$A + \begin{bmatrix} 6 & 6 & 0 & 2 \\ 0 & 12 & 10 & 4 \\ 20 & 4 & 0 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 12 & 9 & 2 & 2 \\ 0 & 16 & 18 & 9 \\ 24 & 6 & 1 & 2 \end{bmatrix}$$

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Scalar Multiplication

- multiplying every element by the same value

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Matrix Multiplication

- If  $A \times B$ , then # columns for A = # rows for B
- If  $A_{m \times n} \times B_{n \times r}$ , then  $AB_{m \times r}$
- Every element in a row from A is multiplied by every element in a column from B and then added together

$$\text{ex } A_{3 \times 2} \cdot B_{2 \times 5} = AB_{3 \times 5}$$

$$\text{ex } A_{4 \times 6} B_{6 \times 1} = AB_{4 \times 1}$$

$$C_{3 \times 2} \cdot D_{3 \times 4} \text{ Not Possible}$$

$$E_{3 \times 3} \times F_{3 \times 3} = EF_{3 \times 3}$$

$$G_{4 \times 3} H_{4 \times 3} \text{ Not Poss.}$$

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Example.

$$C = \begin{bmatrix} 5 & 4 & 8 \\ -2 & 0 & 1 \end{bmatrix}$$

 $2 \times 3$ 

$$D = \begin{bmatrix} -2 & 0 \\ 6 & 4 \\ 1 & -3 \end{bmatrix}$$

 $3 \times 2$  $C \cdot D$   
 $2 \times 2$ 

$$\begin{bmatrix} \underline{1,1} & \underline{1,2} \\ \underline{2,1} & \underline{2,2} \end{bmatrix} \quad \begin{bmatrix} 22 & -8 \\ 5 & -3 \end{bmatrix}$$

$$1,1 \quad 5(-2) + 4(6) + 8(1) = 22$$

$$1,2 \quad 5(0) + 4(4) + 8(-3) = -8$$

$$2,1 \quad -2(-2) + 0(6) + 1(1) = 5$$

$$2,2 \quad -2(0) + 0(4) + 1(-3) = -3$$

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ex:

$$E = \begin{bmatrix} 7 \\ 3 \end{bmatrix}$$

 $2 \times 1$ 

F =

$$\begin{bmatrix} 1 & 5 \\ -3 & 2 \\ 0 & 1 \\ 4 & -2 \end{bmatrix}$$

 $4 \times 2$  $E \times F \rightarrow \text{not possible}$ 

$$\begin{matrix} F \cdot E & = & FE \\ 4 \times 2 & 2 \times 1 & 4 \times 1 \end{matrix}$$

$$\begin{aligned} &1(7) + 5(3) \\ &-3(7) + 2(3) \\ &0(7) + 1(3) \\ &4(7) + -2(3) \end{aligned}$$

$$= \begin{bmatrix} 22 \\ -15 \\ 3 \\ 22 \end{bmatrix}$$

$$\begin{bmatrix} \underline{1,1} \\ \underline{2,1} \\ \underline{3,1} \\ \underline{4,1} \end{bmatrix}$$

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Suppose the profit for each unit of products 1-4 is: 3, 10, 7, and 2 respectively.

What would be the total profit for each factory during the first week?

$$A = \begin{bmatrix} 6 & 3 & 2 & 0 \\ 0 & 4 & 8 & 5 \\ 4 & 2 & 1 & 0 \end{bmatrix}$$

$3 \times 4$

$$P_{4 \times 1} = \begin{bmatrix} 3 \\ 10 \\ 7 \\ 2 \end{bmatrix}$$

$$A \cdot P = \begin{bmatrix} \phantom{0} \\ \phantom{0} \\ \phantom{0} \end{bmatrix}$$

$3 \times 1$

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Homework:

p.164

14, 15, 25, 27

p172-173

13-20(hand), 31-34, 36- 39

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